Lost in Space: The place of the architectural milieu in the aetiology and treatment of schizophrenia.

(DRAFT: IN REVIEW in Facilities)

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Structured Abstract

Purpose: Psychological and epidemiological literature suggests that the built environment plays both causal and salutary roles in schizophrenia, so what are the implications for designers?

Methodology: A translational exploration of the epidemiological, neurological and psychological research that relates to the dynamics between the built environment and psychotic illness.

Findings: The built environment is conceived as being both an *agonist* and as an *antagonist* for the underlying processes that present as psychosis. The built environment is implicated through several means: Through the *opportunities* it provides. These may be *physical*, *narrative*, *emotional*, *hedonic* or *personal*. Some opportunities may be negative, and others positive. The built environment is also an important source of unexpected aesthetic stimulation, yet in psychotic illnesses, aesthetic sensibilities characteristically suffer from deterioration.

This paper focuses on the role the built environment has in environmental × psychological dynamics, in order that deleterious effects can be avoided and beneficial effects emphasised in architectural design.

Limitations and implications: The findings presented are based on research that is largely translated from very different fields of enquiry. Whilst findings are cogent and logical, much of the support is correlational rather than empirical.

Social implications: The WHO claims that schizophrenia destroys 24 million lives worldwide, with an exponential effect on human and financial capital. It is only partly

manageable with medicine, and because evidence implicates the built environment, the onus is on architectural and urban designers to reduce the human costs wrought by the illness.

Originality/value: Never before has architecture been so explicitly implicated as a cause of mental illness. This paper was presented to the Symposium of Mental Health Facility Design, and is essential reading for anyone involved in designing for improved mental health.

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The search for evidence on which to base the design of psychiatric facilities is an important endeavour. But psychiatric illness isn't like orthopaedics or cardiology, where the nature of the illness has nothing much do with the environment except perhaps that it may provide opportunities for fitness or injury. In contrast, the environment is repeatedly found to be a very significant factor in the psychogenesis of mental illnesses – especially with non-affective psychoses. This article is a theoretical discussion about the evidence and how conclusions may be drawn from the patterns we can observe.

Mental illnesses should not be thought of as homogenous. They share some similarities, but also have some very significant differences. In some cases, interventions that promote well-being in one disorder may do the opposite in another (Pei et al., 2010). In fact, not only are mental disorders heterogeneous, the symptoms that they present with are, too (American Psychiatric Association, 1994). Hallucinations, for example, range from very normal experiences through to utterly bizarre and frightening ones. Hay (1994) reports that as many as 60% of people will have experiences that could be classed as hallucinatory, if religious and numinous experience were to be counted. 'Normal' hallucinations, and those associated with dementia are often meaningful and are usually experienced in a single modality – a person may 'see' a deceased relative or angels, for instance. Shizotypal experience, on

the other hand, is far less common: it is usually out of control, is malevolent and most often multimodal – a patient may have the visual and aural experience of having God appear on the TV to command them to commit suicide, for instance (Golembiewski, in review-b, Chadwick and Birchwood, 1994).

Despite the complexities of mental illnesses, the current evidence available to direct design decision-making is mundane, predictable and offers very little insight into the phenomenal impacts of the design. The papers that have been published take a few distinct methodologies, and all have limitations, particularly when it comes to understanding findings. Some are based on post-occupancy studies of units that have been renovated (Eg. Sloan Devlin, 1992, Vaaler et al., 2005, Hurst, 1960). These cannot extend beyond the working principles of the design team and are further limited by the evaluation criteria of the post-occupancy assessors. Another methodology is when design is driven by expert opinions rather than identifiable empirical support (Eg. Davis et al., 1979, Foley and Lacy, 1967, Gutkowski et al., 1992, Gross et al., 1998, Osmond, 1966, Osmond, 1958, Osmond, 1957).

Some researchers seeking design solutions ask the patients. This approach has been effective, but with qualifications. Valid questions hover over the usefulness of patient opinions when patients are typically confused about basic reality. Also, all patient cohorts cannot be represented – the more critical patients who have ‘lost touch with reality,’ (the disorganised or catatonic type schizophrenic patients in particular) are unlikely to give meaningful answers at all, whereas it may be hard to stop patients with manic disorders. For this reason, patient questionnaires are rarely used. Where

useful findings can be uncovered using this approach, they lack depth and insight into the dynamics of the environment on the syndrome's aetiology. Instead they tend to gauge patient satisfaction with one choice or another (Middelboe et al., 2001) (Eg. Perkins, in review, Barnhart, 1996, Larsen, 1992). As examples, Barnhart (1996) found that schizophrenic patients generally prefer garden settings than constructed ones and Larsen (1992) found that schizophrenic patents preferred garden settings that were extremely naturalistic, highly enclosed by shrubbery and extremely complex in contrast to controls who preferred more open gardens, less complexity and more manicured gardens.

Another approach in the literature is to inform design through systematic referral to models of health, illness, stress and psychosocial needs. These methods provide a welcome richness for designers, because they focus on principles, not specifics. These methods can be limited by specificity. Is a study on an Alzheimer's unit applicable to schizophrenia for instance? The neurology, symptoms and apparent phenomenology of Alzheimer's dementia is extremely different from schizophrenia, so the applicability of Zeisel's studies on the environments for Alzheimer's patients (Zeisel, 2005, Zeisel, 2007, Zeisel and Raia, 2000, Zeisel et al., 2003) cannot be naïvely superimposed. Even so, some of the eight principles and sixteen dimensions of Alzheimer's care of (Zeisel) must remain relevant. This draws us toward another approach: the development of design principles that transcend the specifics of illnesses, and are based on models of sickness and health. Examples include: Lawton and Nahemow (1973), Golembiewski (2010), Kaplan (1995), but where focusing on

specific disorders may be too specific, the principles approach may be too generalised.

The approach taken here is not to address problem behaviour (ie. Boredom, getting lost, wandering etc.) but to identify specific aspects of the built environment that appear to be aetiologically related to psychosis, so designers may understand how the built environment actually fosters psychotic experience.

BACKGROUND

Attempts to alleviate the symptoms of schizophrenia by altering the built environment reflect widely held hypotheses that perception is dysfunctional in schizophrenia (Fletcher and Frith, 2009, Kapur, 2003, Kapur et al., 2005, Searles, 1960). These beliefs are supported by the prevalence of hallucinations in 73% (n=980) of diagnoses (Castle et al., 2006) and by a general lack of responsiveness in others (69%, n=935 (McGrath et al., 2009)). Attempts to improve symptoms by altering environments are not uncommon, but are usually guided by naïve models of perception. Changing finishes *does not change* the way things are perceived. A green-coloured bicycle is functionally no different from a peach-coloured one and likewise, peach or green paint on the walls of a day-room cannot change the walls in a meaningful way, even if it does make the place noticeably more cheerful to a healthy visitor. Yes, replicated evidence does suggest that interior decorations, if significant enough, may improve mental health outcomes, lower vandalism rates, and shorten stays (Ulrich and

Parsons, 1990, Sloan Devlin, 1992, Hurst, 1960, Vaaler et al., 2005). These outcomes are welcome, and these innovations may guide designers to make *better* choices, but choices may be improved further because superficial approaches are unlikely to affect the psychogenesis that underlies psychotic states.

It's heretical to suggest that the built environment has a *causal effect* on schizophrenia, but the facts are bare: when other known factors are discounted – 'urbanicity' at the time of birth correlates to an increase in schizophrenia incidence by 28-34.3% (above the null hypothesis), once genetic factors have been discounted (Kelly et al., 2010). Furthermore, epidemiological studies consistently point to a similar figure – assuming that all other factors are even. Data from meta-analyses suggest that urbanicity at any time of life correlates with a 48% increase in schizophrenia incidence. The figure remains reliably high, at around 30% (once again, once other known factors have been discounted) on an exposure = dose basis. This number is one of the highest and most stable epidemiological factors for schizophrenia (van Os, 2004). Ultimately, this builds a compelling argument that the urban environment has a causal effect on psychotic conditions.

The principle has been tested but the reasons remain illusive: A ten minute walk through the dilapidated, but busy Camberwell High Street (South London) demonstrates a *significant* effect on a battery of psychological tests, including Positive And Negative Symptoms Scores (PANSS) (anxiety t (14) = –3.57 (p = 0.003); and paranoia t = –2.69 (p = 0.017, negative scores represent deterioration) (Ellett et al., 2008).

The finger points squarely at the urban environment, but what features of the environment are culpable? Is the urban environment itself a problem, or is it a proxy for something else? Can ‘urbanicity’ stand in for particular social mores, for the prevalence of the built environment, for indoor living? For the psychic pressure of too many people? For richness of opportunity?

Attempts to identify specific environmental psycho-agonists have looked at gene × environment interactions (van Os et al., 2010, van Os et al., 2008), and at social dynamics (Selten and Cantor-Graae, 2007) and (Collip et al., 2008) suggest that the urban environment may represent a concentration of both these factors and more: an increased likelihood of exposure to whatever it is that a patient is sensitised to. This approach seems wise, but it still fails to identify anything specific. The key to identifying environmental psycho-agonists (at the level of detail required by designers) is in the relationship between perception and action.

ECOLOGICAL PERCEPTION:

understanding the action/behaviour expressway.

Mental illnesses are not defined by pathology, but by behavioural symptoms. If the symptoms aren’t disingenuous, then symptoms must be the expressions of a state of mind and reflect natural responses to perceived stimuli, whether they are hallucinatory or real. Certainly delusions (the most prevalent symptom in schizophrenia at 87%, n=1175 (McGrath et al., 2009)) are best understood as being

very genuine expressions of a state of mind that is informed by a perceptual bias (Garety and Freeman, 1999). But how can perception be so disordered that a patient can, in all honesty, mistake people for trees or genuinely believe that the TV is broadcasting messages personally to them?

In order to understand schizophrenic experience, we must first abandon naïve models of perception. Even a lot of scientific literature makes the mistake of assuming that perception is a process where colour, shape, texture and other qualia (sensory information; colours smells etc.) are separated and recombined in the mind to form the objects of knowledge, but this is not a tenable position. We simply cannot have the computing power to recognise every perception from all available data (Clark, 2012 - in press). Certainly this process must occur in healthy perception wherever objects are unrecognisable, but in most instances, perception is *direct* and *active*. One of the best models for understanding this kind of perception is *the Ecological Theory of Perception*. This theory doesn't immediately promise all the answers to the complex questions surrounding psychotic illness, but it does provide valuable insight into phenomenology – the presumed basis for psychotic experience. The principle is that we perceive 'affordances;' opportunities to engage and to act in well-learned or instinctive ways (Bargh and Dijksterhuis, 2001). The cue-behaviour dynamic occurs in a very mechanical way – much as a transplanted heart will automatically start thumping when exposed to warm blood. We notice (and involve ourselves with) things we can directly recognise, manipulate and use (For empirical evidence, see Gibson, 1979). Meanwhile, colours, sounds and other raw sense data are easily missed or immediately forgotten.

Superficial changes do not affect the opportunities a space provides. People act when they recognise affordances, and while colour and shape information may make an affordance more or less recognisable, people do not act on qualia (sense information) as such. The primary task of perception is to initiate action (Gibson, 1979, Bargh and Dijksterhuis, 2001). There are different types of affordances and each has its own lexica of action-responses. Although not all are relevant to architecture as such, they all become relevant to the dynamics within the designed milieu.

EMOTIONAL AFFORDANCES: Some perceptions have direct emotional (affective) meaning. This kind of engagement is very important for humans, with humour automatically soliciting laughter, friendship soliciting happiness, betrayal soliciting anger, and disappointment soliciting resentment etc. But psychotic conditions often prevent emotional affordances from eliciting a normal range of responses. This is particularly so for those with affective psychoses such as *bipolar type 1 disorder* or symptoms of *paranoia* (note that *paranoid schizophrenia* is a technical term that does not necessarily denote the presence of paranoia as such (American Psychiatric Association, 1994)). When affective-spectrum psychotic patients are exposed to circumstances that are rich in emotional affordances, the results correlate to the diagnostic symptoms.

This was found by observing 17 psychotic patients (catatonic schizophrenia, n=3; akinetic type 1 bipolar disorder, n=7; paranoid schizophrenia, n=3; and type 1 bipolar 1, n=7) and ten healthy controls. All subjects had their frontal cortices scanned using functional magnetic resource (fMRI) imaging methods at the same time as they were

shown a series of pictures. Some showed negative content and others positive. One finding was that the psychiatric patients showed very aberrant activation and inhibition patterns when compared to the controls (Northoff et al., 2004). Another was more specific: where the healthy controls *perfectly balanced their neural excitations and inhibitions* in response to the negative images, the patients neural reactions were *out of control.* Aberrant excitation correlates with excessive thought and activity. And where healthy controls showed *some* control for the positive images, the psychiatric patients showed *excessive inhibition*, indicating that they were unable to 'let go' and enjoy a healthy experience. These dysfunctional perceptual reactions appear to explain a wide range of psychotic symptoms including stereotypy and negative thinking patterns (Golembiewski, 2012a).

Emotional affordances are, by and large embodied in the social environment (including pets), but they are also to be found within the arts. The emotional affordances are the product of aesthetic qualities such as beauty and sublimity. Since antiquity beauty has been recognised as a quality of architecture (Vitrivius, circa 15BC) – although the last century has largely disposed of this legacy. Other arts, including the visual arts and music remain very important sources for emotional affordances.

HEDONIC AFFORDANCES: Anything that is known to stimulate hedonic pleasure can become a hedonic affordance. These include substances: 'recreational' drugs and alcohol; and behaviours: gambling, sex, and sometimes theft and violence. In the

context of health facilities, violent behaviour is a significant issue, but other habitual behaviours are largely prevented through lack of opportunity.

Among healthy people, the moderation imposed by neural inhibition renders many hedonic affordances acceptable but without healthy neural inhibition, the use of hedonic stimulants becomes a mental illness in its own right, commonly known as an abuse or addiction (American Psychiatric Association, 1994, Golembiewski, in review-a).

PHYSICAL AFFORDANCES: A very common symptom of schizophrenia is that patients will drink from a glass of that is presented to them, even if they aren't thirsty. The symptom seems innocuous, but the subsequent overconsumption of water has been associated with acutely low sodium levels and there have been published hypotheses suggesting that this may be the cause of schizophrenia (American Psychiatric Association, 1994, Wyatt et al., 1988, Reeves, 2004). While this hypothesis is simplistic and untenable, the symptom draws attention the lack of control that patients demonstrate around *physical affordances*. Physical compulsions are common in a range of organic neurological disorders (Lhermitte et al., 1986). The presence of a syringe solicits a jab, a gun solicits a shot and flowers solicit smelling and picking (Lhermitte, 1986). Louis Kahn also observed that building materials have intrinsic affordances: a brick wants to be built into an arch (1982).

Environments may be rich or starved of such affordances, and if affordances are negative, that might be a good thing, but if they are positive, the result is at best a missed opportunity, and at worst contribute to the pathogenesis of the illness.

IDENTIFICATION AFFORDANCES: Another critical area where the designed environment plays a part in schizophrenia is in the formation of the sense-of-self. There is no consensus about what creates a holistic sense-of-self, but whatever it is, one of the most alarming phenomena in schizophrenia is that the sense-of-self is lost (Kean, 2009, Sass and Parnas, 2001, Searles, 1966). Symptomatically this is classed as a *bizarre delusion* that is particularly characteristic of schizophrenia (American Psychiatric Association, 1994). Delusions are mostly the product of too much top-down intention in the perceptual process (Startup et al., 2008), but other signs - *bizarreness* and a general resistance to anti-psychotic medication (Buckley and Stahl, 2007) suggest the involvement of bottom-up attentional deregulation (Golembiewski, in review-b).

A number of prominent theories emphasize the effect that personal choice has in the formation of a sense-of-self, although there is considerable dispute about why we make those choices etc, (Eg. Bem, 1967, Festinger and Carlsmith, 1959, Deci and Ryan, 1991 (1990)). Mechanics aside, choice of action itself is universally accepted as being important in establishing a sense-of-self. But the sense-of-self is absent when choices are automatic. You don’t choose how to bring a cup to your lip, nor do you

peg your identity on this action. You don't choose how to drive either (once these basic functions have been learned), and if you did, it would be a signal to others that the way you drive is an important expression of self. While automatic choices may define others' impressions of you, your sense-of-self is defined by the choices you make, and by the choices you choose not to make.

The designed environment is possibly the most prominent context for personal choice making, in this regard it is likely to eclipse the social environment in importance – after all, the designed and constructed environment is ubiquitous, whereas the social environment comes and goes. The constructed environment can therefore be understood as being an important domain for self-discovery and therefore for the establishment of a sense-of-self. Choices abound in the negotiation of the built environment and many of them are definitively associated with the sense-of-self. Many of these choices revolve around affordances. What we choose to do, given the opportunity. The major product is what we call 'home'.

In a diminished environment, alternatives (and therefore choices) are restricted. The choice to sit in front of the television is usually hardly a choice at all, if there's nothing else to do. Television may even be harmful because it trains passivity in the face of virtual opportunities and also a sense of unlikely narrative through the storylines of television shows, and this may structurally reinforce delusional patterns of thought (see below).

NARRATIVE AFFORDANCES: Paranoid psychotic patients (the most common subtype of the psychotic spectrum) have a predisposition (a trait, perhaps) to believe that a narrative is being constructed around them and in most cases they are the unwitting protagonist (Gallagher, 2007). These delusional narratives hold that all events ultimately relate to the self. Delusions are nearly ubiquitous in schizophrenia, with paranoid delusions: 87%, *n* = 1163, grandiose delusions: 55%, *n* = 1103 and an unmeasured level of crossover (McGrath et al., 2009). Exposure to any place with strong symbolic loadings and omens of impending disaster or evil must stimulate these delusions – and such omens will be concentrated wherever people an their symbols are concentrated: whether it be the glint in someone's eye, an unusual concentration of police or the odd name of a street.

It only occurred to me that some environments might be particularly loaded with negative or grandiose narrative affordances when I was tracing the steps covered by the Camberwell walk study (discussed above). Firstly it should be noted that this area is known for its extremely high incidence of schizophrenia – as much as 9 times the incidence of areas that are nearby (Kirkbride et al., 2006). My methodology was not scientific, and cannot be reported as such, but the route did cross an *Orpheus Street (figure 1), pass the Pre-Loved store (figure 2), and went past several signs from the Black Katz real estate agent (figure 3). In one place there was a gathering of at least thirty police.* These examples *are* just a few of many more odd and suggestive narrative cues that I experienced in my ten-minute walk. Other notable non-verbal omens I saw included stray dogs, graffiti, pits in the street, ladders leaning over

walkways, Zeus brand motorbike helmets, and ominous posters for games and superhero movies, and a number of extreme an cultish looking places of worship.

Exactly what triggers a delusional quest shall not be discussed here, but once it has commenced, there's little doubt that the urban environment will contain more salient stimuli in which emotionally, physically and narrative cues are present. Without robust inhibition, these will exacerbate delusional beliefs and hallucinations (for an explanation see Golembiewski, 2012a). It has not been tested, but this alone seems sufficient to explain complex patterns of schizophrenia incidence, particularly the increase in urban areas as compared to rural ones. A rural lifestyle is simply going to be less symbolically loaded, more regular, and more benevolent in general.

Given the richness in urban narrative subject matter, it seems that a rural setting could be salutary for patients, simply because of the decreased concentration of these agonists. Thinking along these lines precedes the 'sensitisation hypothesis' by over two hundred and fifty years, and has taken form in some archetypal asylums: the York Retreat and the Kirkbride units that were constructed in the nineteenth Century (Yanni, 2007). But confusingly, circumstantial evidence demonstrates that schizophrenic patients like being in the city. Healing the country may be, but schizophrenic patients show a tendency to drift into the 24/7 red light areas of the big metropolises, where they sleep rough in doorways, traffic islands and in areas often recognised for the highest levels of substance induced violence. Psychiatric migration isn't huge, but what there is, flows *to the centre* rather than into the more calming environments of small towns and the country. A traditional (but still current)

argument links this psychiatric migration to poverty (Read, 2010). But where city centres were once cheap, the opposite is usually the case now, and yet wanderers still roll in. So another hypothesis is proposed: that the frenetic action of inner city life may provide *comfort*, much as others need quiet and security. And although frenetic city life may indeed increase the symptoms, it may also provide relief to a particularly troubling symptom, the loss of the means to experience reality partly free from troubling delusions and hallucinations. To understand this phenomenon, it's necessary to look at another aspect of perception: this time at *selective attention theory*.

SELECTIVE ATTENTION

The perceptual psychology cannon allows for two kinds of attention: *bottom-up and top-down.* Bottom-up attention is drawn to stimuli that are *unexpected and unsought*, and top-down attention is given to *expected or intended phenomena*. Affordances (discussed above) are perceived through top-down attention, along with any experiences that are in line with on-going thought patterns and well-learned behaviours. Enquiry (rather than action) is triggered by bottom-up attention. Thus action-responses to bottom-up perceptions are not automatic. Events that draw bottom-up attention beg questions. Unusual opportunities, awe and unexpected experiences are brought to attention by bottom-up processes.

Where top-down attention is stimulated very easily and requires little stimuli, bottom-up attention requires more momentous events to draw attention. These include

significant mismatches with normal expectations, sudden contrasts and prominent sense data and information (Golembiewski, in review-b, Theeuwes et al., 1998).

Both the bottom-up and top-down modes of attention appear to be moderated by dopamine (Grace et al., 2007), a neurotransmitter that is dysfunctional in schizophrenia, Parkinson's disease, depression and most other mental illnesses. Errors in top-down attention processing correlate with the so-called 'positive symptoms;' these are delusions, hallucinations, disorganised speech and thought and grossly disorganised behaviour (American Psychiatric Association, 1994). Bottom-up attentional dysfunctions also correlate to disorganised speech and behaviour, but even more so to the 'negative signs' the noticeable absences of normal behaviour that are very difficult to treat pharmacologically (Golembiewski, in review-b).

What this means in schizophrenia, is that prominent, awesome or unexpected things tend to be missed, even when they are plainly obvious. Bottom-up attention deficits are not easy to observe as an outsider, but may account for the more severe and troubling symptoms of schizophrenia and other mental illnesses. These deficits present a whole host of problems, not least of all a tendency to miss evidence that contradicts delusional reasoning (Broome et al., 2007). The inability to engage with awe (even if only occasionally) is possibly sufficient to cause depression, debilitate good judgement, erode a sense of well-being and contract the perception of time, so that it always feel like it's running out (Rudd et al., 2012). Other bottom-up perception abilities are even more critical; the ability to listen to endogenous signals

that tell us we're hungry, tired, happy or miserable, the signals that guide us socially and monitor whether our behaviour is appropriate or not, etc.

Deficits of bottom-up attention seem to give rise to very worrisome symptoms. Social dysfunction, isolation, hunger and confusion can all be traced to this deficit. Therefore hypothesis that schizophrenic migration to the bus-stops in the red-light districts of metropolises may be in order to elicit external stimulation becomes highly tenable.

Facility designers should be aware that end users with bottom-up attention deficits will be especially prone to accidents, getting lost and a general obliviousness to abstract and aesthetic concerns such as time and beauty (Golembiewski, in review-b). But equally so, environments that don't challenge bottom-up attention with the possibility of error and opportunities for discovery and aesthetic stimulation may only make bottom–up attention deficits worse. So a careful balance is required - improved safety measures and way-finding will be essential, but must be balanced with aesthetic generosity, lighting that reinforces diurnal rhythms and a richness of opportunities to act in a fulfilling and positive way.

The oversensitivity of top-down attention (the mechanism that brings things to attention because they are anticipated) is ubiquitous in psychotic conditions (Kapur, 2003, Fletcher and Frith, 2009).

The combination of top-down oversensitivity and bottom-up attentional deficiency exacerbates persecutory or grandiose delusions because patients will overvalue unimportant, but expected perceptions (Chadwick, 1992, Freeman and Freeman, 2008) while missing contrary facts. This phenomena, known as a *confirmation bias*, is very common even outside of mental illness, but in paranoid states it is ubiquitous (Nickerson, 1998, Broome et al., 2007). Most people with face-to-face experience with schizophrenic and bipolar type I patients recognise this syndrome and recall patients who may be standing there, wearing two left shoes, claiming that they have re-cognised Einstein's theory of relativity. The patient's claims are reinforced by top-down oversensitivity (false 'eureka experiences') while oblivious of something obviously amiss is a product of bottom-up attention deficiencies.

Where a patient's delusions and hallucinations are often a worry for other people, they contribute to a sense of comprehensibility for the patient themselves – at least *the patient is* sure about what's going on and why (even when they're wrong) (Bergman et al., 2012). This knowledge may not be much use to negotiate the world, but it does add to an overall sense of coherence, and that is certainly beneficial (Golembiewski, 2012b) and delusions should not be treated as a problem, but as coping strategy when formulating a *model of care* (the functional program) for a facility.

BRINGING THE THEORY TO PRAXIS
the architectural milieu

When discussing opportunities to address schizophrenic dysfunction with architecture, a caveat is required. Any changes to safety, security and operational systems need to reflect and parallel changes to the model of care. Furthermore, support from all stakeholders should also be in place (Plsek and Wilson, 2001). There can be no doubt that security and operational features are essential for the function of a psychiatric facility and arguments against their removal will include fears that opportunities for self-harm, violence and vandalism may increase. Having said this, *the possibility that safety concerns are in conflict with health issues is also real* (Chrysikouin this issue, Bowers et al., 2010), and in the interests of good practice, must be discussed with all stakeholders in a frank and open way. Some patients are not at risk of suicide, and others are. Patients are individuals and so are their circumstances (For a review of specific factors see Bowers et al., 2010). Some provisions that are essential for one patient will be detrimental for another, and as such, a diversity of spaces and provisions should be designed for. Alternatively, units should be customised for the individual conditions that they are to treat.

ADDRESSING BOTTOM-UP ATTENTION DEFICITS

If bottom-up atrophy can be successfully addressed, the deficit signs of schizophrenia will definitively show improvement. As it stands, pharmacological treatment for the deficit signs is “at best modest… results have been largely disappointing.” (Buckley and Stahl, 2007), This leaves a huge onus on alternative treatments, including

improved environments. How bottom-up attention may be stimulated in a positive way without stimulating top-down attention is a difficult problem.

Converging lines of evidence suggest deficits of bottom-up attention are partly caused by the built environment, but there's little doubt that the same symptoms diminish an architect's toolkit to deal with it. In Bottom-up attentional deficiencies mean that prominent design features may simply not be noticed, and if they are, top-down attentional surpluses mean that features may only be noted only because they feed on-going delusions. For example, a red feature may be noticed, not because of the prominence of the colour in the context, but because red is interpreted to mean power or some other such delusion (Reina, 2010).

Eventually a tailored in depth cross-sectional study will be needed to pinpoint more specifics of causal relationships that the built environment have with schizophrenia, but evidence is already strong enough to justify assuming causality. In the same way, WHO advises caution with mobile phones because they are linked to the recent glioma epidemic, although the mechanism has not yet been identified (WHO and IARC, 2011). There is still every possibility that the removal of psychosis agonists and provisions intended to counteract deficit signs will not reverse schizophrenia, but because even minor environmental changes improves outcomes, a targeted and informed approach may yield remarkable results. Interventions may work directly or assist natural recovery.

AESTHETIC AND NATURAL ENGAGEMENT: Because positive bottom-up attention is engaged by aesthetics, *good, beautiful, natural* and especially *awe-inspiring* design may be restorative.

Unfortunately, there's no easy guideline that will ensure good and beautiful results, and just about any attempt to do so will incur extra costs in construction. This nebulous objective will also prove difficult to quantify because bottom-up attention is notoriously difficult to assess (Theeuwes et al., 2000) as are aesthetics, which are subjective. The objective of aesthetic appeal in architecture has a long tradition – perhaps older than man's ability to build. It is the third of Vitruvius' classical qualities of good building; "*firmitas, utilitas, venustas,"* that is, the importance of the *delight* that architecture can evoke (Vitrivius, circa 15BC).

ENVIRONMENTAL GENEROSITY: The atrophy of bottom-up attention has a biological correlate: reduced synaptic plasticity. This affects learning, spatial cognition, information and logic handling, other cognitive functions and leads to dementia (Stephan et al., 2009, Schultz and Dickinson, 2000). Similarly, a socially and materially deprived environment has also been shown to cause synaptic atrophy – at least in rats, which are easier to observe and test ethically than humans (Hall et al., 1998). Whether these losses occur for humans or if they are associated with the psychogenesis of schizophrenia is still unknown, but should be considered. And any positive or neutral enrichment of the environment should improve synaptic plasticity.

Environmental richness will therefore directly assist recovery, quite apart from the effects these efforts will have on attention systems.

DEALING WITH TOP-DOWN SUPERFLUITY: Another approach to take in design intervention for psychotic conditions is to enrich spaces with positive affordances. Top-down attention is a mode that is concerned only for engagement. For this reason, designers should focus on what positive activity and entertainment the space can provide and on the redesign of the opposite – avoiding negative design language and passive environments.

The biggest scale of architectural intervention will be at the level of typology. Typology is the classification of function according to appearance; (a house that looks like a house, a bank that looks like a bank etc.) the main function of typology is information: it informs people about the nature of the place they are visiting. As Kahn puts it, “rooms suggest their use without a name” (Kahn, 1971). Strong typology simplifies understanding, orientation and way-finding (Lynch, 1992). But not all typology is equal. Typology is symbolically and phenomenologically loaded, and so sensitivity needs to be given to types that may have negative meanings. Negative typologies may include prisons, hospitals, schools, courts, psychiatric facilities, seclusion rooms and other institutional buildings (Golembiewski, 2010).

Spatial arrangement within an environment is important because it has a direct effect on how people navigate and use the space. This becomes increasingly important as skills and cognitive abilities atrophy. For best effect, space should be logical, non-repetitive and well marked with memorable objects and functions.

Opportunities for engagement also exist at a smaller scale. We do not regularly engage in walls, and although we constantly do engage with the floor, it's only because the ground beneath us is as ubiquitous as the prevalence of gravity. For the best part, we use the ground automatically, not as a matter of active engagement. We may be more inclined to engage in architectural elements if they offered us something more, like if they have to be negotiated in some way. Aalto had people engage with the floor by bringing it up closer to the eye level of a seated person – he created step-down living spaces. Walls would come alive with washable crayons and licence to scribble. It's true that given a chance, some paranoid patients will use the opportunity to write threats and draw obscenities. But if these expressions were easily erased, even this kind of expression may still be helpful – at least it shows engagement and is a distraction from more harmful pursuits (Golembiewski, 2012b).

We engage with objects, particularly interesting ones (is not *engaging* a synonym of *interesting*?) more than we do with basic building elements. Our bodies are designed to interact with movable objects and moving parts. Light switches, venetian blinds, knickknacks and furniture are the sorts of ordinary moving objects in the built environment that we regularly engage with. Architectural elements like these are designed for our bodies and actively invite engagement. We fill our homes, hotels

and workplaces with such things – probably because they fortify mental well-being. Ironically, the few places that are stripped of physical affordances are the places that need them most - prisons and psychiatric facilities - because such facilities are designed with safety as a priority over healing. This is exemplified by the overuse of anti-ligature devices - showerheads that don't direct the water properly, doorknobs that can't be grasped, tap-less basins, and furniture that is blind-bolted to the floor. Institutional strip-lighting is recessed and secured and blinds are often secured behind tempered glass. It is not unusual for anything that moves to be controlled remotely by nurses. The intention behind the installation of these components is clear; to restrict possible affordances for self-harm, but the result is that the affordances of the environment are restricted to an absolute minimum.

Top-down attention (the relevant mode for the engagement in affordances) is driven by the tonic dopamine system, which is thought to be overexcited in schizophrenia (Heinz and Schlagenhauf, 2010, Grace et al., 2007). This means that *psychotic patients have a stronger drive to engage than healthy people do*, even though the drive may be masked by catatonic symptoms or deficit signs (Northoff et al., 2004, Sass and Parnas, 2001) The 'irresistible' drive to engage is demonstrated in the emotional image study detailed above (Golembiewski, 2012a). In this context, *the removal of physical affordances is predicted to only frustrate patients and aggravate symptoms, if not the underlying pathology of the disorder.* Given the removal of positive affordances, negative intentions are likely to become only more focused. It is important to note that even healthy people start having hallucinatory and delusional experiences when all affordances are taken away (Grassian, 1983, Weckowicz, 1957).

To counter this, Osmond (1957, 1958) (an experienced clinician and one of the leading authors on the subject of the design of the psychiatric milieu) recommended movable furniture, the provision of equipment to play music, to write etc. Now we should go further: design teams should actively think about the creation of *positive* affordances: the provision of a multisensory environment filled with relatively harmless but fun toys, sports equipment, drawing tools, opening windows, doors that have a pleasing sound when closed, adjustable lighting, heating and ventilation etc.

CONCLUSION

Ascertaining what is ‘bad’ and what is ‘good’ in an architectural context is not particularly difficult, but there’s no scientific method for such assertions. A level of subjectivity means that there will be specific exceptions for particular patients, particularly if they suffer from paranoia. For this reason, special care should be taken not to rely on *neutral* affordances because context will have a major bearing on this judgement. Exactly the same ‘neutral’ affordances can be taken as either positive or negative, depending on whether circumstances are judged as aversive (Freeman and Freeman, 2008).

The image study (Northoff et al., 2004) used generic emotive photographs to solicit emotional responses, and so can architects and designers. Ulrich identified views of trees as positive (Ulrich and Parsons, 1990, Ulrich, 1991), and current projects that employ these concepts have been spectacularly successful (see figure 4). The ability

to engage with plants to touch them and lie under them is likely to be an even stronger positive affordance, although there is a reticence to plant trees in or around psychiatric facilities due to a risk of self-harm. Other architects have been experimenting with the inclusion of animal enclosures in their hospitals, also with wonderful feedback (see figure 5). But the salutary potential of architectural care goes far beyond trees, animals and emotive pictures. *All positive affordances are likely to support the recovery from all mental illnesses, where negative ones appear to make the conditions worse.* There are affordances everywhere, seats to sit on, apples to eat, windows to open, books to read. Most of these are positive, but care should be taken, because potential negative associations aren't always obvious because of symbolic encoding (eg. the thirteenth room along a corridor) or linguistically associations (eg. the association between Lucifer and Lucite; a brand of transparent acrylic used in skylights) etc.

Any opportunities that engage in personal choice are particularly important because they will contribute to a sense-of-self. But the most illusive opportunities are those that will have the strongest salutary effect (if any effect can be evoked at all) – *sublimity and abundant beauty*. The response to unintended delight is one of the most profound atrophies in schizophrenia and one, what's more, that is currently untreatable using pharmacological interventions.

Figure 1: Orpheus St., Camberwell. Could this be taken as an omen by a superstitious person?

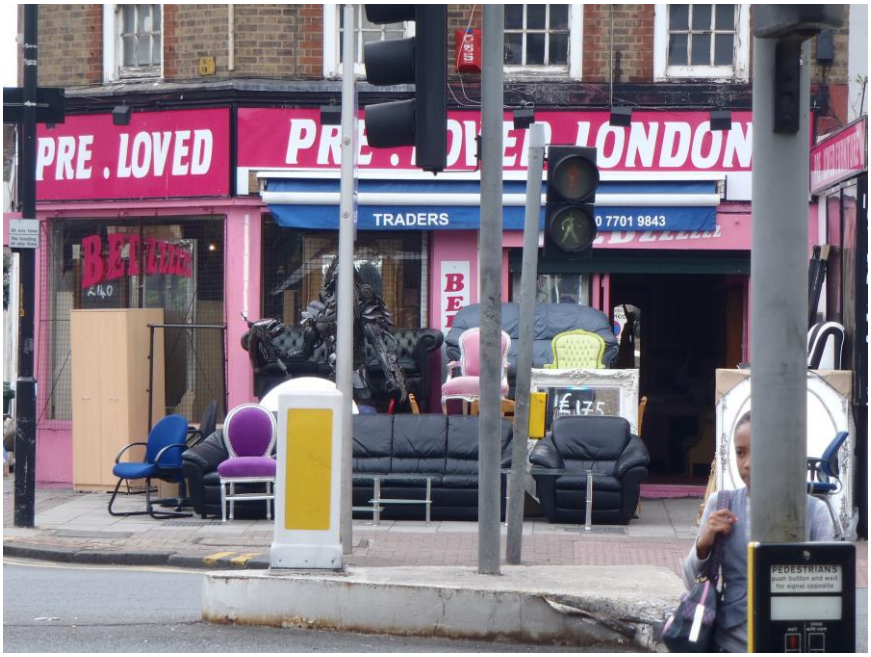

Figure 2, The Preloved Store, Camberwell. The richness of potentially negative symbolic associations in Camberwell is extraordinary. Could the high incidence of schizophrenia in the area reflect this?

Figure 3, Black Katz Real Estate signs are common in Camberwell. Being rental agents, they probably have to evict people who don't pay their rent.

Figure 4, A patient reads the paper in one of the abundantly green courtyards of Khoo Teck Hospital, Singapore (by CGC Architects).

Figure 5, Bates Smart and Billard Leece (architects) took great efforts to make the Royal Children's Hospital in Melbourne a positive experience. They even have a meercat enclosure in the ambulatory waiting room.

American Psychiatric Association 1994. *Diagnostic and Statistical Manual of Mental Disorders (DSM),* Washington D.C., American Psychiatric Association.

Bargh, J. A. & Dijksterhuis, A. 2001. The Perception-Behavior Expressway: Automatic Effects of Social Perception on Social Behavior. *Advances in experimental social psychology,* 33**,** 1-40.

Barnhart, S. K. 1996. *Examining the Relationship between Behavioural and Environmental Setting Preferences among Patients and Staff at a Psychiatric Hospital.* MLA, University of Guelph (Canada).

Bem, D., J. 1967. Self-Perception: An Alternative Interpretation of Cognitive Dissonance Phenomena. *Psychological Review,* 74**,** 183-200.

Bergman, E., Malm, D., Ljungquist, B., Bertero, C. & Karlsson, J.-E. 2012. Meaningfulness Is Not the Most Important Component for Changes in Sense of Coherence. *European Journal of Cardiovascular Nursing***,** j.ejcnurse.2011.05.005.

Bowers, L., Banda, T. & Nijman, H. 2010. Suicide Inside: A Systematic Review of Inpatient Suicides. *The Journal of Nervous and Mental Disease,* 198**,** 315-328.

Broome, M. R., Johns, L., Valli, I., Woolley, J., Tabraham, P., Brett, C., Valmaggia, L., Peters, E., Garety, P. & Mcguire, P. 2007. Delusion Formation and Reasoning Biases in Those at Clinical High Risk for Psychosis. *The British Journal of Psychiatry,* 191**,** s38-s42.

Buckley, P. & Stahl, S. 2007. Pharmacological Treatment of Negative Symptoms of Schizophrenia: Therapeutic Opportunity or Cul De Sac? *Acta Psychiatrica Scandinavica,* 115**,** 93-100.

Castle, D., Jablensky, A., Mcgrath, J., Carr, V., Morgan, V., Waterreus, A., Valuri, G., Stain, H., Mcguffin, P. & Farmer, A. 2006. The Diagnostic Interview for Psychoses (Dip): Development, Reliability and Applications. *Psychological Medicine,* 36**,** 69-80.

Chadwick, P. 1992. *Borderline; a Psychological Study of Paranoia and Delusional Thinking,* London, New York, Canada, Routledge.

Chadwick, P. & Birchwood, M. 1994. The Omnipotence of Voices. A Cognitive Approach to Auditory Hallucinations. *The British Journal of Psychiatry,* 164**,** 190-201.

Chrysikou, E. in press. Accessibility for Mental Healthcare. *Facilities*.

Clark, A. 2012 - in press. Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science. *Behavioral and Brain Sciences*.

Collip, D., Myin-Germeys, I. & Van Os, J. 2008. Does the Concept of "Sensitization" Provide a Plausible Mechanism for the Putative Link between the Environment and Schizophrenia? *Schizophrenia Bulletin,* 34**,** 220-225.

Davis, C., Glick, I. D. & Osow, I. 1979. The Architectural Design of a Psychotheraputic Milieu. *Hospital and Community Psychiatry,* 30.

Deci, E. L. & Ryan, R. M. A Motivational Approach to Self: Integration in Personality. *In:* Dienstbier, R. A., ed. Nebraska Symposium on Motivation, 1991 (1990) Lincoln. U. Nebraska Press, 237-288.

Ellett, L., Freeman, D. & Garety, P. 2008. The Psychological Effect of an Urban Environment on Individuals with Persecutory Delusions: The Camberwell Walk Study. *Schizophrenia Research,* 99**,** 77-84.

Festinger, L. & Carlsmith, J. 1959. Cognitive Consequences of Forced Compliance. *Journal of Abnormal and Social Psychology,* 58**,** 203-210.

Fletcher, P. C. & Frith, C. D. 2009. Perceiving Is Believing: A Bayesian Approach to Explaining the Positive Symptoms of Schizophrenia. *Nat Rev Neurosci,* 10**,** 48-58.

Foley, A. R. & Lacy, B. N. 1967. On the Need for Intraprofessional Collaboration: Psychiatry and Architecture. *American Journal of Psychiatry,* 123**,** 1013-1018.

Freeman, D. & Freeman, J. 2008. *Paranoia the 21st Century Fear,* Oxford, New York, Oxford University Press.

Gallagher, S. 2007. Pathologies in Narrative Structures. *Royal Institute of Philosophy Supplement,* 60**,** 203-224.

Garety, P. & Freeman, D. 1999. Cognitive Approaches to Delusions: A Critical Review of Theories and Evidence. *British Journal of Clinical Psychology,* 38**,** 113-154.

Gibson, J. J. 1979. *The Ecological Approach to Visual Perception,* Boston, Houghton Mifflin Company.

Golembiewski, J. 2010. Start Making Sense; Applying a Salutogenic Model to Architectural Design for Psychiatric Care. *Facilities,* 28**,** 100-117.

Golembiewski, J. 2012a. All Common Psychotic Symptoms Can Be Explained by the Theory of Ecological Perception. *Medical Hypotheses,* 78**,** 7-10.

Golembiewski, J. 2012b. Psychiatric Design: Using a Salutogenic Model for the Development and Management of Mental Health Facilities. *World Health Design Scientific Review,* 5**,** 74-79.

Golembiewski, J. in review-a. Introducing the Concept of Reflexive and Automatic Violence: A Function of Aberrant Perceptual Inhibition. *Psychology of Violence.*

Golembiewski, J. in review-b. The Riddle of Psychotic Perception Resolved; an in-Depth Analysis of Aberrant Salience Hypotheses for Schizophrenia.

Grace, A. A., Floresco, S. B., Goto, Y. & Lodge, D. J. 2007. Regulation of Firing of Dopaminergic Neurons and Control of Goal-Directed Behaviors. *Trends in Neurosciences,* 30**,** 220-227.

Grassian, S. 1983. Psychopathological Effects of Solitary Confinement. *American Journal of Psychiatry,* 140**,** 1450-1454.

Gross, R., Sasson, Y., Zarhy, M. & Zohar, J. 1998. Healing Environment in Psychiatric Hospital Design. *General Hospital Psychiatry,* 20**,** 108-114.

Gutkowski, S., Ginath, Y. & Guttmann, F. 1992. Improving Psychiatric Environments through Minimal Architectural Change. *Hospital and Community Psychiatry,* 43.

Hall, F., Wilkinson, L., Humby, T., Inglis, W., Kendall, D., Marsden, C. & Robbins, T. 1998. Isolation Rearing in Rats: Pre-and Postsynaptic Changes in Striatal Dopaminergic Systems. *Pharmacology Biochemistry and Behavior,* 59**,** 859-872.

Hay, D. 1994. 'The Biology of God': What Is the Current Status of Hardy's Hypothesis? *International Journal for the Psychology of Religion,* 4**,** 1-23.

Heinz, A. & Schlagenhauf, F. 2010. Dopaminergic Dysfunction in Schizophrenia: Salience Attribution Revisited. *Schizophr Bull***,** sbq031.

Hurst, L. 1960. The Environment in Chronic Schizophrenia. *International Journal of Social Psychiatry,* 7**,** 65.

Kahn, L. 1971. The 1971 Aia Gold Medal Address: The Room, the Street and Human Agreement. USA: American Institute of Architects.

Kahn, L. 1982. 1973: Brooklyn, New York. *Perspecta,* 19**,** 89-100.

Kaplan, S. 1995. The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology,* 15**,** 169-182.

Kapur, S. 2003. Psychosis as a State of Aberrant Salience: A Framework Linking Biology, Phenomenology, and Pharmacology in Schizophrenia. *Am J Psychiatry,* 160**,** 13-23.

Kapur, S., Mizrahi, R. & Li, M. 2005. From Dopamine to Salience to Psychosis--Linking Biology, Pharmacology and Phenomenology of Psychosis. *Schizophrenia research,* 79**,** 59-68.

Kean, C. 2009. Silencing the Self: Schizophrenia as a Self-Disturbance. *Schizophr Bull,* 35**,** 1034-1036.

Kelly, B. D., O'callaghan, E., Waddington, J. L., Feeney, L., Browne, S., Scully, P. J., Clarke, M., Quinn, J. F., Mctigue, O. & Morgan, M. G. 2010. Schizophrenia and the City: A Review of Literature and Prospective Study of Psychosis and Urbanicity in Ireland. *Schizophrenia Research,* 116**,** 75-89.

Kirkbride, J. B., Fearon, P., Morgan, C., Dazzan, P., Morgan, K., Tarrant, J., Lloyd, T., Holloway, J., Hutchinson, G. & Leff, J. 2006. Heterogeneity in Incidence Rates of Schizophrenia and Other Psychotic Syndromes Findings from the 3-Center Aesop Study. *Arch Gen Psychiatry,* 63**,** 250-258.

Larsen, L. S. 1992. *Nature as Therapy: An Assessment of Schizophrenic Patients' Visual Preferences for Institutional Outdoor Environments.* Masters of Landscape Architecture, University of Guleph.

Lawton, M. P. & Nahemow, L. 1973. Ecology and the Aging Process. *In:* Eisdorfer, C. & Powell Lawton, M. (eds.) *Social Environment of Aging.* USA: American Psychological Association.

Lhermitte, F. 1986. Human Autonomy and the Frontal Lobes. Part II: Patient Behavior in Complex and Social Situations: The 'Environmental Dependency Syndrome'. *Annals of Neurology,* 19**,** 335-343.

Lhermitte, F., Pillon, B. & Serdaru, M. 1986. Human Autonomy and the Frontal Lobes. Part I: Imitation and Utilization Behavior: A Neuropsychological Study of 75 Patients. *Annals of Neurology,* 19**,** 326-334.

Lynch, K. 1992. *The Image of the City,* MIT press.

Mcgrath, J. A., Avramopoulos, D., Lasseter, V. K., Wolyniec, P. S., Fallin, M. D., Liang, K.-Y., Nestadt, G., Thornquist, M. H., Luke, J. R., Chen, P.-L., Valle, D. & Pulver, A. E. 2009. Familiality of Novel Factorial Dimensions of Schizophrenia. *Arch Gen Psychiatry,* 66**,** 591-600.

Middelboe, T., Schjødt, T., Byrsting, K. & Gjerris, A. 2001. Ward Atmosphere in Acute Psychiatric in Patient Care: Patients' Perceptions, Ideals and Satisfaction. *Acta Psychiatrica Scandinavica,* 103**,** 212-219.

Nickerson, R. S. 1998. Confirmation Bias: A Ubiquitous Phenomenon in Many Guises. *Review of General Psychology,* 2**,** 175-220.

Northoff, G., Kötter, R., Baumgart, F., Danos, P., Boeker, H., Kaulisch, T., Schlagenhauf, F., Walter, H., Heinzel, A. & Witzel, T. 2004. Orbitofrontal Cortical Dysfunction in Akinetic Catatonia: A Functional Magnetic Resonance Imaging Study During Negative Emotional Stimulation. *Schizophrenia Bulletin,* 30**,** 405.

Osmond, H. 1957. Function as the Basis of Psychiatric Ward Design. *Mental Hospitals,* 8**,** 23-27.

Osmond, H. 1958. The Seclusion Room-Cell or Sanctuary? *Mental Hospitals,* 9**,** 18-19.

Osmond, H. 1966. Some Pychiatric Aspects of Design. *In:* Holland, L. B. (ed.) *Who Designs America?* Anchor Books: New York.

Pei, L., Li, S., Wang, M., Diwan, M., Anisman, H., Fletcher, P. J., Nobrega, J. N. & Liu, F. 2010. Uncoupling the Dopamine D1-D2 Receptor Complex Exerts Antidepressant-Like Effects. *Nature Medicine,* 16**,** 1393-1395.

Perkins, N. in review. Including Patients, Staff and Visitors in the Design of the Psychiatric Milieu: Notes from the Field. *Facilities.*

Plsek, P. E. & Wilson, T. 2001. Complexity, Leadership, and Management in Healthcare Organisations. *BMJ,* 323**,** 746-749.

Read, J. 2010. Can Poverty Drive You Mad? 'Schizophrenia', Socio-Economic Status and the Case for Primary Prevention. *New Zealand Journal of Psychology,* 39**,** 7-19.

Reeves, R. 2004. Worsening of Hyponatremia with Electrolyte- Containing Beverage. *American Journal of Psychiatry,* 161**,** 374-375.

Reina, A. 2010. The Spectrum of Sanity and Insanity. *Schizophrenia Bulletin,* 36**,** 3-8.

Rudd, M., Vohs, K. D. & Aaker, J. 2012. Awe Expands People's Perception of Time, Alters Decision Making, and Enhances Well-Being. Stanford University, Graduate School of Business.

Sass, L. & Parnas, J. 2001. Phenomenology of Self-Disturbances in Schizophrenia: Some Research Findings and Directions. *Philosophy, Psychiatry, & Psychology,* 8**,** 347-356.

Schultz, W. & Dickinson, A. 2000. Neuronal Coding of Prediction Errors. *Annual Review of Neuroscience,* 23**,** 473-500.

Searles, H. F. 1960. *The Non-Human Environment in Normal Development and in Schizophrenia,* New York, International Universities Press.

Searles, H. F. 1966. Concerning the Development of an Identity. *Psychoanalytic Review,* 53**,** 7-30.

Selten, J. P. & Cantor-Graae, E. 2007. Hypothesis: Social Defeat Is a Risk Factor for Schizophrenia? *The British Journal of Psychiatry,* 191**,** s9-s12.

Sloan Devlin, A. 1992. Psychiatric Ward Renovation: Staff Perception and Patient Behavior. *Environment and Behavior,* 24**,** 66-84.

Startup, H., Freeman, D. & Garety, P. 2008. Jumping to Conclusions and Persecutory Delusions. *European psychiatry : the journal of the Association of European Psychiatrists,* 23**,** 457-9.

Stephan, K. E., Friston, K. & Frith, C. D. 2009. Dysconnection in Schizophrenia: From Abnormal Synaptic Plasticity to Failures of Self-Monitoring. *Schizophrenia Bulletin,* 35**,** 509-527.

Theeuwes, J., Atchley, P. & Kramer, A. F. 2000. On the Time Course of Top-Down and Bottom-up Control of Visual Attention. *Control of cognitive processes: Attention and performance XVIII***,** 105-124.

Theeuwes, J., Kramer, A. F., Hahn, S. & Irwin, D. E. 1998. Our Eyes Do Not Always Go Where We Want Them to Go: Capture of the Eyes by New Objects. *Psychol Sci,* 9**,** 379-385.

Ulrich, R. S. The Effects of Interior Design on Wellness; Theory and Recent Scientific Research. Journal of Health Care Interior Design; Proceedings from the National Symposium on Health Care Interior Design, 1991. 97-109.

Ulrich, R. S. & Parsons, R. Influences on Passive Plants in Individual Well-Being and Health. Proceedings of the National Symposium on the Role of Horticulture in the Well-Being and Social Development, 1990 Washington DC.

Vaaler, A., Morken, G. & Linaker, O. 2005. Effects of Different Interior Decorations in the Seclusion Area of a Psychiatric Acute Ward. *Nordic Journal of Psychiatry,* 59**,** 19-24.

Van Os, J. 2004. Does the Urban Environment Cause Psychosis? *British Journal of Psychiatry,* 184**,** 287-288.

Van Os, J., Kenis, G. & Rutten, B. P. F. 2010. The Environment and Schizophrenia. *Nature,* 468**,** 203-212.

Van Os, J., Rutten, B. P. & Poulton, R. 2008. Gene-Environment Interactions in Schizophrenia: Review of Epidemiological Findings and Future Directions. *Schizophrenia Bulletin,* 34**,** 1066-1082.

Vitrivius circa 15BC. De Architectura. *In:* Howard, A. A. (ed.) *Ten books of architecture.* Ancient Rome.

Weckowicz, T. E. 1957. Notes on the Perceptual World of Schizophrenic Patients. *Mental Hospitals (Architectural Supplement),* 8.

Who & Iarc 2011. Iarc Classifies Radiofrequency Electromagnetic Feilds as Possibly Carcinogenic to Humans. World Health Organisation.

Wyatt, R., Alexander, R., Egan, M. & Kirch, D. 1988. Schizophrenia, Just the Facts. What Do We Know, How Well Do We Know It? *Schizophrenia research,* 1**,** 3.

Yanni, C. 2007. *The Architecture of Madness; Insane Asylums in the United States,* Minnesota, University of Minnesota Press.

Zeisel, J. 2000. Environmental Design Effects on Alzheimer Symptoms in Long Term Care Residences. *World Hospitals and Health Services,* 36**,** 27-35.

Zeisel, J. 2005. Environment, Neuroscience, and Alzheimer's Disease. *Alzheimer's Care Today,* 6**,** 273.

Zeisel, J. 2007. Creating a Therapeutic Garden That Works for People Living with Alzheimer's. *Journal of Housing For the Elderly,* 21**,** 13-33.

Zeisel, J. & Raia, P. 2000. Nonpharmacological Treatment for Alzheimer's Disease: A Mind-Brain Approach. *American Journal of Alzheimer's Disease and Other Dementias,* 15**,** 331-340.

Zeisel, J., Silverstein, N. M., Hyde, J., Levkoff, S., Lawton, M. P. & Holmes, W. 2003. Environmental Correlates to Behavioral Health Outcomes in Alzheimer's Special Care Units. *The Gerontologist,* 43**,** 697-711.